

Hun (E. R.)

NEW YORK STATE MEDICAL SOCIETY.

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# TRICHINA SPIRALIS:

BY E. R. HUN, M. D.

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PRESENTED TO THE NEW YORK STATE MEDICAL SOCIETY,  
AT THEIR ANNUAL MEETING FOR 1869.

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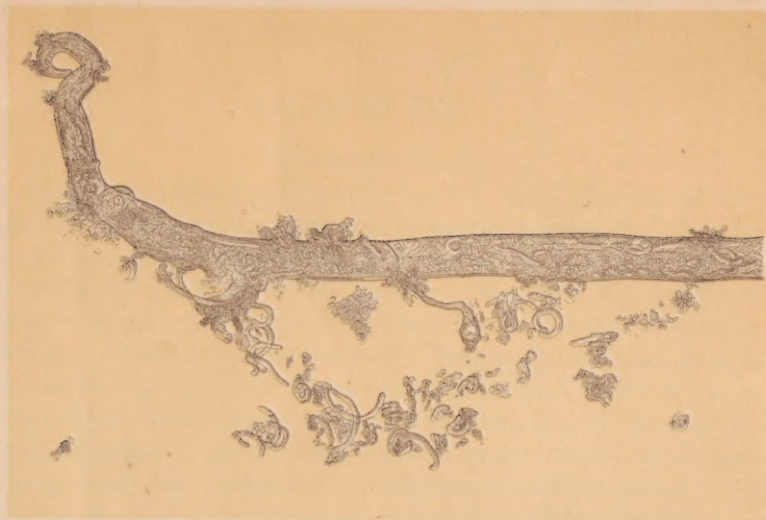
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## ARTICLE XII.

*Trichina Spiralis.*

In December, 1868, I was invited by Dr. C. D. Mosher, of this city, to visit, with him, a patient who presented a series of symptoms which did not correspond with those characteristic of any of the diseases ordinarily met with in this locality. We found the patient, a German boy, ten years of age, lying upon his back, and complaining bitterly upon being moved or touched. Face puffy and considerable œdema of the legs and feet; tongue red and inclined to be dry; considerable thirst, with little or no desire for food; bowels tympanitic, but not remarkably tender; frequent, soft, green stools; urine normal in quantity and containing no albumen; constant cough with expectoration of a thick, tenacious mucus, sometimes streaked with blood, and at others resembling the rusty sputa of pneumonia; loud mucous râles over both sides of the thorax with bronchial respiration and slight crepitation, with dullness on percussion near the spine on the right side; pulse ranged from 125 to 135 per minute.

Upon asking the history of the case we found that the illness commenced about six weeks previously with puffiness of the eyelids and face, followed by vomiting and general gastric disturbance. Soon after the arms and legs became tender and sensitive to the touch and muscular movement became difficult and painful; at the same time diarrhœa came on; about the end of the second week a peculiarity developed itself in the gait of the patient who walked upon his toes, as if unable to rest his heels upon the floor. The symptoms gradually increased in severity, and for the past two weeks the suffering has been so great as to compel complete confinement to bed, and the general soreness and pain have been greatly aggravated by the constant cough which commenced about ten days ago.

Upon further inquiry, we discovered that a brother of the patient had been attacked at the same time and in the same manner, but the symptoms were milder in his case, and had lasted only three weeks. We examined him carefully and detected nothing except a slight tenderness on pressure over the right deltoid muscle.

The diagnosis of trichinosis which I had already formed by exclusion was rendered still more probable from the fact that the two boys had, a few days previous to their illness, eaten some raw pork which they found lying upon the table waiting to be cooked for dinner, which pork was afterward boiled and eaten by the whole family (con-



sisting of five persons), none of whom seem to have experienced any ill consequences except the two boys.

In order to make my diagnosis certain I had an instrument constructed with which to harpoon and remove a small piece of muscle and having anæsthetized the skin over the deltoid muscle of the boy who had recovered, by means of the rhigolene spray, I tore out a few muscular fibres and submitted them to microscopic examination. Several trichinæ were found coiled up and in a quiescent condition, surrounded by a mass of granular and fibrous tissue but without any trace of calcareous deposit.

I continued to visit the patient, with Dr. Mosher, from this time, December 24th, until January 15th, when he died. During this period the pain and tenderness continued and the diarrhœa resisted all remedies. The cough was incessant, and he complained at times of noises in his ears.

The *autopsy* was made 48 hours after death.

*Head.* — Not examined.

*Thorax.* — No pleuritic effusion. The heart appeared normal. The lung tissue upon section presented a very bright, red appearance, similar to that observed in the lungs of animals during vivisection.

*Abdomen.* — Peritoneum, smooth and shining; no effusion. Liver, clay-colored and very much enlarged. Intestines not opened. Spleen and other organs appeared normal.

*Microscopic Examination.* — Portions of the heart, lungs, liver and kidneys were examined, and no trichinæ found in them, but in the diaphragm, pectoral, psoas and gastrocnymius muscles great numbers of the parasites were discovered, some of them encysted, and others free and full of life and motion.

I fed some of this muscle to a female rabbit, which died four days afterward, and upon opening the stomach and intestines I found a great number of fully developed trichinæ of both sexes. The females were filled with ova and living young, and one of them gave birth to a large family of embryos while under observation with a half-inch objective.

Thinking the subject to be one of interest and importance as regards the public health, I have appended the following account of the trichina spiralis which I have gathered from the works of several French and German authors :

#### TRICHINA SPIRALIS.

The first reliable mention we find of the trichina is that by Mr. Hilton, who, in making the autopsy of a man 70 years of age in Guy's hospital, London, found a great number of white corpuscles, scattered through the fibres of the pectoral muscles. He considered



them as being probably small cysticerci, but did not describe their organization. This observation of Mr. Hilton was read before the Medico-Chirurgical society, of London, at a meeting held January 23, 1833, and was published in the Medical Gazette the following February.

About this time Paget noticed a similar appearance in the muscles of an Italian who died at St. Bartholomew's hospital, and carried some of the little specks to the celebrated naturalist, Richard Owen, by whom they were carefully examined and studied.

Owen then read a memoir on this subject to the Zoölogical Society of London, which was published in the Medical Gazette in April, 1835. In this memoir, which was the first work published on the subject, the author states that the little white points implanted in the muscles are in reality cysts of an ovoid form and containing a microscopic worm, to which he gave the name of *trichina spiralis*, from the Greek word *τρίχis*, because the worm is slender, like a hair, and is usually rolled up in a spiral coil.

During this same year, 1835, Dr. Wood, of Bristol, published a case of what he supposed to be acute rheumatism with pulmonary and cardiac complications, and in which an autopsy revealed a large number of trichinæ in the muscles.

Soon after this, Harrison published in the Dublin Journal six cases of trichinosis.

Owen himself, then collected all the observations which had been published and gave them to M. Bureau-Riofrey, who, in 1836, published the fourteen cases thus pointed out to him.

During the next ten years scarcely any mention was made of the trichina in medical literature.

In 1845, Dujardin began to study the origin of the trichina, and in a short time all the helminthologists became interested in this research and sought for it in different animals. Herbst in 1845 and Gurlt in 1849 found it in the cat, and it was also met with in the mouse, badger, and even in the muscles of a sparrow.

But the most important discovery was made in America by Professor Jos. Leidy, in 1847, when he found the parasite in pork. Luschka in 1851 gave a correct description of the anatomy of the worm, describing the mouth, œsophagus, intestinal canal and anus, but did not find any sexual organs.

This description was followed by the monographs of Henle, Küchenmeister, Bristowe and Rainey, and finally by the first works of Virchow upon this subject. Kuchenmeister considered the trichina to be merely a development of the trichocephalus, in which opinion he was opposed by Virchow, who failed to find the genital organs

characteristic of the latter, and who considered that the trichina might possibly be the production of some other entozoon, the strongylus for example, the only thing which appeared to him probable, was that the trichina might, like the cysticercus or echinococcus, continue its development in the intestine of the carnivora.

From the above account we see that in 1859 the trichina had frequently been found in man and other animals, but nothing was as yet known as to its origin, or as to its capability of producing any disease.

On the 12th of January, 1860, a servant girl aged 20 years, entered the hospital at Dresden, under the care of Dr. Walther. She had been sick for about twenty days, and had kept her bed since the 1st of January. At the commencement she had great lassitude, thirst, anorexia and constipation. To these symptoms, which still persisted, were added a burning fever, tympanitis and abdominal pains, in fact, an assemblage of severe symptoms which were attributed to typhoid fever. Soon, however, the patient developed new symptoms not usual in that disease; such as violent pains, continuing day and night, and which were principally located in the extremities; very frequent contractions of the arms and legs with flexion of the elbows and knees, during which all attempts at extension were very painful. Later, there was œdema of the limbs, especially of the legs; finally, symptoms of typhoid pneumonia came on, and the patient died the 27th of January. The nature of the disease was not at all understood during life.

Zenker, having studied the case, made the autopsy himself. The muscles of the arm were first examined; they were pale, of a greyish, red color, and appeared speckled. The professor examined a small piece of this muscle under the microscope, and saw with astonishment a large number of free trichinæ in the muscular parenchyma, assuming all postures and giving the most incontestible evidences of vitality. Continuing his examinations, he found all the muscles so studded with trichinæ, that under a low magnifying power he perceived as many as twenty in one field of the microscope. He was then sure that the worms had been detected during their passage into the muscles. The muscular fasciculi gave evidence of marked degeneration; they were friable and the fibres were no longer striated nor homogeneous.

No lesion elsewhere was found which would justify the idea of typhoid fever; no splenic enlargement nor alteration of the mesenteric ganglia; the left lung was collapsed with points of infiltration; the bronchi were inflamed, and the mucous membrane of the ileum very hyperæmic.



The penetration of the trichinæ into the muscles was then not only the cause of the violent muscular pains, but also the true cause of death.

As the patient had been brought to the hospital from the country, Zenker made some researches, and found that about four weeks previously a hog had been slaughtered at the house from which this girl had come. He also found that the ham and sausages made with the flesh of this animal contained a large number of trichinæ, and that the butcher who had dressed the hog and had eaten raw sausages, as well as several others, had, like them, presented more or less severe rheumatismal and typhoid symptoms, but the patient who had been sent to Dresden was the only one who had died from eating the pork.

Zenker sent to Virchow a portion of the muscles of the dead girl, and by a series of experiments upon rabbits several doubtful points were elucidated and definitely settled. It was found that when a rabbit was fed upon the flesh containing trichinæ the animal became emaciated and feeble during the succeeding three or four weeks, and died toward the fifth or sixth week, with its muscles filled with the entozoa. In this manner Virchow obtained five generations of trichinæ.

Since 1860 numerous works upon this subject have been published by different authors, as Davaine, Pietra Santa, Kestner, Rodet, Virchow and Leuckart. But of all the works which have yet appeared, that of Pagenstecher seems the most complete, in which are given the results of a number of experiments made upon various animals at the Zoölogical Institute, of Heidelberg, by the author and J. Fuchs.

We now come to the consideration of the successive transformations which the trichina passes through during its existence.

When an animal contains trichinæ in its muscles, they are usually found enveloped in a little capsule, which is formed in its interior, of a smooth, transparent membrane, and externally, of a calcareous deposit. If the flesh containing these trichinæ is eaten by a carnivorous animal the gastric and intestinal juices dissolve this envelope and the worms are set free, and soon arrive at a complete stage of development. The females are fecundated by the males, and the embryos are soon born.

When the generative function has been accomplished by the trichinæ, they die, and are expelled from the intestine with the fecal matter. The young embryos, whose number is immense, perforate the walls of the intestine, penetrate into the abdominal cavity and pass from thence into all the muscles of the body. When they have finished their immigration, they lodge in one of the fibres of the muscle, become encysted and remain quiescent for an indefinite period of time; they die in this condition, unless the animal containing them



is eaten in his turn, when the trichinae pass through a cycle of existence similar to that of those worms which engendered them.

We will now review each of these stages in detail.

*1st. The Formation of the Cyst.* — The cysts of the trichina are formed of a double envelope. First, an external one which is formed from the sarcolemma of the muscular fibre in which the worm is lodged, and which is terminated at both its extremities by an elongated fibre. Second, an internal one of ovate form, and with very thin, transparent walls, which is considered to be the production of the trichina itself. After a time calcareous matter is deposited in these cysts, and this cretification gradually advances until the parasite is entirely concealed from view.

The cavity contained in the cyst is sufficiently large to allow its occupant a slight degree of motion. The great majority of the cysts contain only one worm, but sometimes we find two, or even three in the same envelope.

How long the trichina is capable of living inclosed in this manner is as yet undecided, but many observers have found them alive after several years of inclusion. However, they do finally die, and their death is accompanied by the deposition of earthy matter in the body of the worm and in the cavity containing it, so that at last we have a solid mass of calcareous matter, which afterward undergoes segmentation and then breaks up.

The habitual location of the encysted trichina is in the muscles of the trunk and limbs, especially near the insertion of tendons and aponeuroses; they are even found in the muscles of the eye and internal ear, but they accumulate in large numbers in the diaphragm, the posterior muscles of the neck, the biceps, deltoid, etc., etc. Thus far the encysted trichina has not been found in the muscles of the heart, but they have been met with in this organ in an embryonic condition.

The number of trichinae contained in the muscles varies according to the quantity of infested meat ingested. It has been estimated that many millions may be contained in a single individual. A single mouthful of meat may, therefore, easily contain two or three thousand.

*2d. Intestinal Trichina.* — When a portion of meat containing trichinae reaches the stomach, it rapidly undergoes certain changes which are due to the digestive power of that organ. The meat being reduced to a pulraceous mass, exposes the capsules of the entozoon to the action of the gastric and intestinal secretions, and the acids contained in these fluids dissolve the calcareous matter and set the trichinae free. At the moment when the animal escapes from the cyst it measures from  $\frac{1}{30}$  to  $\frac{1}{25}$  of an inch in length, and at this period no sexual organs can be distinctly observed.

Twenty-four hours after being set at liberty in the intestine, the trichinae have already acquired a considerable degree of development, the sexual organs are now apparent; by the third or the fourth day the ova can be distinguished in the ovary of the female and spermatie cells in the male. The male has now a length of about  $1\frac{1}{2}$  of an inch, and can be distinguished from the female by two projections, constituting a kind of forked appearance at the extremity of the tail, and which represents the genital organs.

The females assume larger proportions, and rapidly reach from  $\frac{1}{8}$  to  $\frac{1}{6}$  of an inch in length, and look like very fine white threads, which are perceptible to the naked eye.

Copulation soon takes place, and the ova can be seen to swell in the ovary of the female, and five or six days later, minute, living young make their exit from the uterus. These little ones are of extremely small size, measuring only from  $\frac{1}{300}$  to  $\frac{1}{200}$  of an inch; their number is prodigious; a single female being capable of producing as many as one thousand young.

When the processes of fecundation and reproduction are terminated the old trichinae die and are expelled with the faeces. Usually all the above functions are performed within from twelve to fifteen days; but Pagenstecher has found female trichinae, still living, two months after the introduction of the encysted worms into the stomach, and this fact makes it possible that the same individual may give birth to more than one brood of young.

The number of females is always greater than of males, and the difference has been variously estimated between two to one and forty to one.

*3d. Migration of the Embryos.* — When we consider how very prolific this parasite is, we might, at first, be astonished that in one instance only have the trichinae been found in an embryonic state in the intestinal canal. The fact is that these embryos are scarcely born before they bore into the walls of the intestine, and according to Virchow penetrate into the epithelial cells of the mucous membrane.

Some authors consider that the embryos reach the muscular tissue by being carried along in the circulation, but this opinion is refuted by Virchow and Pagenstecher, who have never been able to discover them in the blood or in the vessels.

When the young trichinae have perforated the intestine they are found in large numbers in the serous cavities, especially in the peritoneum and pericardium; they make their way into the mesenteric glands, the spleen and above all into the diaphragm, where they remain permanently and become encysted.

The trichinae, continuing their emigration, finally reach the primitive muscular fibrils, and it is during this period, while they are moving, that the patients complain of pain. The trichinae never locate themselves in the cellular tissue, but traverse it so rapidly that they have never been discovered in it.

The embryos, which, at the time of their birth, measured only about  $\frac{1}{250}$  of an inch, gradually increase in size for six or seven weeks, deriving their nutriment at the expense of the muscular fibre in which they are lodged, until they are simply inclosed in a tube formed by the myolemma. By this time they have attained between  $\frac{1}{50}$  and  $\frac{1}{25}$  of an inch in length, and their growth is arrested. They now become surrounded by a capsule, which is in due time enveloped in a deposit of calcareous matter. When thus encysted, they may live for a number of years, and there are cases on record where they survived thirteen years in an encysted condition, after which they were capable of producing trichinosis in rabbits.

We see from the above that the trichinae pass through a cycle of existence which may be divided into three distinct periods, viz.: First, the period when they exist as encysted larvæ; second, the period of development and procreation; third, the embryonic stage.

The anatomy of the trichina is much more complicated than its diminutive size would lead us to suppose. The adult trichina is a cylindrical, transparent worm, scarcely perceptible to the naked eye.

The anterior extremity is very pointed, while the posterior extremity is rounded and obtuse, presenting a terminal anus which looks like a little depression. All along the body, but, especially, toward its posterior portion, small transverse striae may be seen, which are the folds formed of the dermis by the action of the longitudinal muscle. The intestinal canal extends from the mouth to the anus, and is divisible into three portions: The œsophagus, stomach and intestine. The mouth is not easily seen, it is round, and not furnished with hooks, or any prehensile apparatus. The œsophagus is very long, occupying two-thirds of the whole length of the body and terminates by a constricted opening into the stomach, which is a very small, oval cavity, about one-thirtieth of the length of the digestive canal. The intestine goes directly to the anus, and is of nearly uniform diameter.

Pagenstecher claims to have discovered the brain of the trichina, and represents it as located behind the mouth, and in front of the œsophagus.

No blood vessels have been discovered, but blood globules have been recognized in the connective tissue.

The lower portion of the body of the trichina is traversed longi-



itudinally by muscular fibres which seem to form bands. Posteriorly and entirely underneath, are two other muscles, called retractors of the *cloaca*.

When the trichina reaches the adult stage, the generative organs, which, previously, were only rudimentary and entirely invisible, become rapidly developed, and acquire a size equal to one-half the body of the male, and four-fifths that of the female. In the male, at each side of the anus, are two oval appendices, convex outward, and concave inward, and pointed at their free extremity; these are the *vesiculae seminales*, and are terminated above by a *vas deferens* which carries the semen into the *cloaca*. Between these two vesicles the penis projects at the moment of copulation.

The female trichina is viviparous. The vulva is situated at the anterior and inferior fifth of the body, so that the embryos escape from the uterus from behind forwards. The ovary is situated immediately above the uterus; it forms a closed sac above, and contracts below before opening into the uterus.

Many observations have been made upon animals to see which of them are naturally infected with trichinæ.

At first, the earth worm was said to contain them, but Virchow, Gerstaecker, and, especially, Kühn, who made special investigations into the subject, declared that the conformation of the head and tail of the parasite found in the earth-worm bore no analogy to the same parts in the trichina. Besides which, the latter can only be developed in the muscles of warm-blooded animals.

Several observers claim to have observed the trichina in moles, but, according to Virchow, the results of their investigations appear to be at least doubtful.

The rats and mice infesting houses frequently are infected, so that cats are exposed to the disease, and, as hogs, also, are known to eat rats and mice, they may become trichinosed in this manner.

The most complete study with regard to the artificial trichinisation of animals, is that by MM. Fuchs and Pagenstecher, who made various experiments upon animals of all classes, from the mammals to the molluscs.

1st. *Mammals*.—The dog, after eating infected meat, does not become trichinosed. The trichinae, it is true, undergo their usual development in the intestines, and propagate young, but the latter do not find their way into the muscles, from some unknown cause: the old and young passing off together with the intestinal evacuations. This is also true of the fox.

The cat undergoes trichinisation easily and completely, and so does the rabbit. Experiments made upon the goat show that the male

can never, and the female but seldom, become infected. It is hardly necessary to state that swine become trichinosed with extreme facility.

The calf is susceptible of artificial infection, but attempts upon the bull, ox and cow have been unsuccessful. The sheep can be trichinosed, but only with great difficulty.

The Guinea-pig, rat and mouse are easily infected, so are, also, the hare and wild boar.

The birds cannot be trichinosed, at least, MM. Fuchs and Pagenstecher found it so in their investigations, thus differing from some other authors. Experiments were made upon the cock, hen, goose, turkey and pigeon, and afterward upon the rook, starling, magpie, jackdaw, peacock, buzzard, and several birds of prey. In all of these the trichinae grew, and, in some instances, propagated in the intestines, but were soon carried off with the alvine evacuations.

Fish readily eat the meat, but the trichinae perishes without development. The same is the case with frogs, and several varieties of salamanders.

Among the crustacea, the lobster only was experimented upon; the result was nil.

As a result of these researches, we find, that among the animals used for food, the hog is the only one which presents any danger.

Historical researches, and especially the observation of individual cases of trichinosis, have enabled us to arrange a complete tableau of the disease. The results produced by the ingestion of infected meat necessarily vary, according to the number of worms swallowed, the impressionability of the patient, and the time which has elapsed since the invasion. The disease may, therefore, be divided into four stages.

*First Period.* — It lasts from eight to ten days; trichinous meat, introduced into the stomach, passes into the intestines; the cysts are ruptured and the larvæ grow and arrive at a complete stage of development.

In the great majority of persons no effect is produced the first day, a few, however, feel a malaise, vomit and experience slight symptoms of indigestion. If the meat, only partially smoked, or salted, was undergoing putrefaction, serious accidents may be produced, constituting a form of poisoning called in Germany wurstgift (sausage poison), which sometimes terminated fatally. Usually it is not until the third or fourth day that the following symptoms are manifested: loss of appetite, nausea, general malaise, fatigue, thirst, frequent alvine evacuations, and then diarrhœa and fever.

This period offers no special characteristic by which it can be distinguished from an ordinary irritation of the stomach and intestines produced by some accidental cause, but it corresponds perfectly to

the phenomena of the evolution of the trichinae; in fact, these worms, whose number is often prodigious, irritate the mucous membrane and determine all the symptoms of a commencing gastro-intestinal inflammation.

*Second Period.* — It corresponds to the birth of the embryos, which, in millions, perforate the intestinal walls and provoke an aggravation of all the symptoms; the fever increases, the pulse beats from 120 to 130 per minute, the capillary circulation is disturbed, œdema of the face commences, often first observed in the eyelids; the thirst is intense, the lips and tongue become dry and brown, the perspiration is abundant, and there are alternations of diarrhœa and constipation. The mind remains clear through all this disorder. This second period has a duration of from eight to twelve days.

*Third Period.* — The embryos having pierced the intestines, are scattered over the abdominal and thoracic serous membranes, and thence penetrate into the muscles. Then commence the muscular pains, which rapidly increase in severity and become atrocious; the muscles of the upper extremities contract, the arms are semi-flexed, and every effort to extend them calls forth cries of distress; the patient walks upon his toes, as if unable to let his heels down to the floor;\* the movement of the pectoral muscles being impeded, render respiration difficult; the trichinae which penetrate into the tongue and larynx embarrass deglutition and occasion enfeeblement of voice; the patient remains motionless in bed, and bed-sores form upon the points compressed; the œdema increases, ascites comes on, and the inferior extremities sometimes acquire an enormous size; the pains are incessant; the urine is scanty; there is profuse perspiration, and the wakefulness is persistent; the intelligence remains unimpaired, notwithstanding the constant torture of the patient; the muscles of the extremities swell up, offering an elasticity like that of india rubber; at times the patient experiences a transitory desire for food. Soon all the symptoms become aggravated, the diarrhœa augments, the thirst is unquenchable and delirium comes on, and is sometimes permanent; finally, after six weeks, two months, or even longer, exhaustion draws the sad scene to a close.

*Fourth Period.* — The symptoms of the third stage, although often very severe, do not always reach a fatal termination: they commence to subside, either under the influence of the strong constitution of the

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\* This symptom I have not met with in any account of the disease which I have seen, although it was very marked in the two cases which fell under my own observation, and constituted one of the principal features in an epidemic of trichinosis which occurred at one of our orphan asylums, under the care of my father, Dr. Thomas Hun.



patient, or because the number of trichinae injected has not been very large. The gastric phenomena become ameliorated, the appetite reappears, and the diarrhoea ceases; the fever, muscular pains and œdema diminish. These happy symptoms appear after one and a half or two months, which correspond to the period when the trichinae became encysted. When this phenomenon is accomplished, the trichinae are no longer in direct contact with the muscles, being inclosed in capsules, which increase in thickness, become incrustated with calcareous salts, and remain indefinitely as foreign bodies without occasioning any defect in movement.

During the convalescence, which is long, the hair falls and the nails often become detached, sometimes, also, large flakes of epidermis are cast off.

The complications which may arise during the course of the disease are numerous, and it is not uncommon to meet with pleuritic effusions, pneumonia, cutaneous eruptions, furuncles and sloughs which take place about the trochanters and the sacrum.

When death terminates the sufferings of the patient, we find, at the autopsy, evidences of the disorders observed during life. The intestines are inflamed, red and sometimes ulcerated; the mucus which they contain is viscous and abundant; occasionally, but rarely, adult trichinae are found in them, but usually they have been expelled in the stools. The liver and spleen preserve their normal appearance. If pulmonary symptoms have been present during the illness, we will find evidences of disease in the lungs or pleuræ, but these pathological changes present nothing special or characteristic, and microscopic investigation is necessary, in order to find the lesion peculiar to trichinosis. A few fibres taken from the diaphragm or muscles of the neck will, when placed under the microscope, demonstrate the existence of the parasite.

It may here be stated that the trichinae have never been discovered in the blood vessels, nor in the blood itself, and that the kidneys, bladder and brain are habitually in a condition of perfect integrity.

It cannot be denied that trichinosis is a very severe and dangerous disease, but still its mortality is usually overestimated, as will be seen from the following statistics, gathered from some of the epidemics of this malady:

At Plauen, there were 3 deaths in 30 cases, $\frac{10}{100}$ .					
" Calbe,	"	8	"	38	" $\frac{21}{100}$ .
" Hettstedt,	"	27	"	158	" $\frac{13}{100}$ .
" Bourg,	"	11	"	50	" $\frac{22}{100}$ .
" Hadersleben,"	"	80	"	300	" $\frac{27}{100}$ .

The danger of the disease evidently depends upon the number of

entozoa introduced into the stomach, and the age and constitution of the patient will, also, greatly influence the prognosis. From the present statistics, it appears that the mortality is greater among women and children than among men.

The diagnosis of trichinosis is by no means easy, at least if we rely only upon the symptoms presented by the patient. According to the period in which we see it, we may mistake it for gastric fever, typhoid fever, renal disease, or rheumatism. There is, however, one infallible means of confirming our diagnosis in cases where we suspect the disease, which consists in removing a small portion of the biceps or deltoid muscle and submitting it to a microscopic examination. Welker, of Halle, thought an examination of the under surface of the tongue, with a convex lens, would reveal the presence of the parasite, and Küchenmeister hoped to be able to see them under the mucous membrane covering the gums, but their attempts to do away with the more painful, but more certain, proceeding of removing a small portion of the muscle for examination, have not been attended with success.\*

The medical treatment of trichinosis presents two indications: First, the prevention of the infection of the muscular system; and, second, the cure of the disease after attempts to avert it have not been successful.

Circumstances rarely afford an opportunity to act immediately after the ingestion of the infected meat, for, usually, the patient himself does not know his own danger. If, however, we should discover that such meat had been swallowed, and had reason to think, from the lapse of time, that it still remained in the stomach, a free recourse to emetics should at once be made.

If the trichinae are in the intestines, we must resort to purgatives, and, probably, the best agent would be castor oil, which serves the double purpose of destroying the parasite by closing its pores and evacuating the alimentary canal.

Many physicians associate vermifuges with purgatives, and san-tonine, etherial extract of male fern, pomegranate rind, kousso, etc., have been used. Küchenmeister recommends calomel and jalap, fol-

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\* This is done by means of a peculiarly formed trocar and canula. The trocar has a piece filed out near the point in such a manner as to form a barb, and the canula is cut short, so as to be drawn far enough back to expose this notch in the trocar. The instrument when used is introduced through the skin into the muscle to be examined, and then the canula is drawn back sufficiently to expose the barbed point. A rotary movement being given to the trocar, a small portion of the muscle is torn off and drawn back into the canula, and after withdrawing the instrument a few muscular fibres will be found retained in the notch cut in the trocar, which may be submitted to microscopic examination.

lowed the next day by powder of jalap and powder of male fern, until the patient has at least six or seven liquid stools. Many other remedies have been tried, as camphor, bichloride of mercury, sulphur, phosphorus, arsenic, chloroform, alcohol, salt, etc., etc., and all of them have failed. Finally, MM. Leuckart and Mosler called medical attention to benzine, which they considered to be really efficacious. Rodet repeated their experiments, obtaining, as he thought, a remarkably good result, but he afterward failed, in repeating his experiments upon a rabbit.

Dr. Friedreich claimed that the picronitrate of potassa was a certain remedy against trichinosis, but in direct experiments upon animals, he found that this remedy, even in large doses, neither killed the trichinae in the intestines nor in the muscles, and besides it exerted a poisonous influence upon the animals to whom it was administered.

Notwithstanding the various remedies employed, we must acknowledge that as yet no very marked success has been obtained, and this fact may be due to the remarkable vitality of the trichina as well as to its extreme tenuity, which enables it to avoid direct contact with the medicines by concealing itself in the folds of the mucous membrane. The immense fecundity of this entozoon will also explain how the escape of a few adults from destruction in the intestine may allow of the birth of thousands of embryos.

In the present state of our knowledge, we can therefore consider the preventative measures as the only efficacious means to be employed against the disease.

We cannot judge from the appearance or the history of a living hog, whether it contains trichinae or not, for many cases are on record where these animals have been carefully raised upon good food and under strict surveillance and have never been observed to be sick, and yet their muscles have been found studded with trichinae.

In December, 1863, the authorities of the city of Brunswick made the microscopic examination of pork obligatory, and appointed certain physicians to attend to it. Between December, 1863, and December, 1865, 30,000 hogs were examined, and only two cases of the disease were found among them. In the city of Blankenbourg, however, four cases were found among seven hundred hogs examined. In Saxony the proportion was still greater, and in a little village near Hadersleben three cases of trichinous hogs were discovered within a very short space of time.

Many persons are now of the opinion that they must abstain entirely from pork in order to avoid danger, but this is an exaggeration, and the only thing which it is necessary to proscribe is raw pork.



By experiment it has been found that a temperature of  $212^{\circ}$  is fatal to the trichina, but in order that the interior of a large piece of meat should attain this degree of heat, it must be submitted to a thorough process of boiling, roasting or frying as the case may be, since it very often happens that the meat appears externally well cooked while the interior is almost raw.

Salting or smoking pork, unless very complete, do not destroy the entozea, and Leuckart has observed the trichina to resist exposure to cold as low as  $13^{\circ}$  F.

From the above it is evident that as a rule it is not entirely safe to depend simply upon curing or cooking pork to prevent danger in eating it, and the butchers in Germany, seeing that their business was liable to suffer, began themselves to take measures to calm public inquietude. In several cities, the butchers formed associations for the purpose of examining the pork and insuring one another against losses. In order to avoid all attempts at fraud, they fixed the value of the animal according to its weight, and added about one cent a pound to the current market price, and if any butcher found that he had a trichinous hog in his possession, he received from the association the full value of the animal, besides a premium of fifty thalers.

In other parts of Germany, where the examination of each hog was enforced by the authorities, the butchers formed companies for the purpose of insuring one another against losses.

The following official communication will serve as an example of the manner in which they should be worded and the strictness with which they should be enforced.

#### ORDINANCES AND PUBLICATIONS OF THE AUTHORITIES OF THE PROVINCE OF MAGDEBOURG.

##### *Police Ordinances.*

In order to avoid the injurious effects resulting from eating trichinous pork, upon human life and health, we order, in virtue of the law regulating the police administration, dated March 11, 1850, throughout our jurisdiction, as follows :

1. Whoever slaughters a hog, or causes one to be slaughtered, is obliged to have it microscopically examined by an expert appointed by the authorities for this purpose; and it will only be after a certificate shall have been given by the expert that he has found that the pork contains no trichinae, that the flesh can be sold or prepared for human food. Whoever disobeys this law is liable to a fine of from five to ten thalers.

2. When a hog is found to be trichinous, the expert should at once inform the local police.

Every part of a trichinous hog should at once be destroyed, under penalty of a fine of ten thalers; and, for this purpose, should be delivered to the Knacker (*equarisseur*), who is obliged to bury them according to the law, in default of which he is fined ten thalers. Besides, those who not having obeyed the orders above mentioned, shall have been the cause of the trichinous meat being sold, and of its use as food having injured the health of a human being, or even produced his death, will be prosecuted before the tribunals and punished according to the penal code.

#### EXPLANATION OF PLATE.

Fig. 1.—The anterior third of an adult female trichina, with embryos. Obtained from the small intestine of a rabbit four days after the ingestion of a piece of trichinous human flesh.

Fig. 2.—A portion of human muscle, containing a number of recently encysted trichinæ.

Fig. 3.—A muscular trichina, preparatory to its becoming encysted.

Fig. 4.—An old encysted trichina. The cyst undergoing calcareous degeneration.

Fig. 5.—An old cyst, which, having undergone complete calcareous degeneration, is now breaking up, preparatory to its final destruction.

NOTE.—The above figures are lithographed from microscopic photographs of specimens which are now in my possession.

E. R. HUN.









